

Part I – Conceptual Understanding

1. Define an orbit using a complete physics explanation (not just “going around Earth”).

2. Why is orbit described as “continuous free fall”?

3. Why do astronauts feel weightless in orbit even though gravity is still acting on them?

4. If a satellite suddenly lost all sideways velocity, what would happen? Why?

Part II – Gravity & Inverse Square Law

Newton’s Law of Gravitation:

$$F = G (m_1 m_2 / r^2)$$

5. If the distance between two objects doubles, how does the gravitational force change?
Show reasoning.

6. If the distance increases by a factor of 3, how does the force change?

7. Why does gravity weaken with altitude?

Part III – Orbital Velocity (Algebra & Proportional Reasoning)

Orbital velocity equation:

$$v = \sqrt{GM / r}$$

8. According to this equation, what two variables determine orbital velocity?

9. Why does satellite mass not appear in the final velocity equation?

10. If orbital radius doubles, what happens to orbital velocity? Show reasoning.

11. If orbital radius increases by a factor of 4, what happens to orbital velocity?

12. If orbital radius decreases, does velocity increase or decrease? Explain why.

Part IV – Graph Interpretation

13. Is the relationship between orbital velocity and orbital radius linear? Explain.

Part V – Application & Critical Thinking

14. Why do satellites in Low Earth Orbit (LEO) complete an orbit faster than satellites in Geostationary Orbit (GEO)?

15. Why must rockets turn sideways after launch instead of continuing straight up?

16. Explain why escape velocity does not depend on the mass of the rocket.

Part IV – Graph Interpretation

17. Is this relationship between orbital velocity and orbital radius linear? Explain.

Part V – Geostationary Orbit (GEO)

18. What is special about a geostationary satellite’s orbital period?

19. Why must a geostationary satellite orbit far from Earth?

Use the equation $v = \sqrt{GM / r}$ in your explanation.

20. Why must a geostationary satellite orbit above the equator?

21. Why can’t a satellite in low Earth orbit stay over one location?

Part VI – Escape Velocity

Orbital velocity ≈ 7.8 km/s

Escape velocity ≈ 11.2 km/s

22. Explain the difference between orbital velocity and escape velocity.

23. Why is escape velocity larger?

24. Does escape velocity depend on the mass of the rocket? Explain.
